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STUDY OF BROADCASTING TECHNIQUES FOR PROMOTING THE EXTENSION OF COVERAGE AND IMPROVEMENT OF MASS COMMUNICATIONS

(Project No. 9.556.07)

FIRST PHASE REPORT

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INTRODUCTION

The contribution of broadcasting infrastructure to the economy and social development of developing communities is no more an issue for debate. The question of relative expense (capital and operational) of sub-systems such as transmission, production and distribution is of considerable importance in development planning. For developing countries with scarce resources either of skill or finance, continuous efforts are called for in the provision of less expensive and complex sub-system alternatives if they are to establish viable broadcasting systems with full and effective national coverage physically as well as in terms of output.

In the African region of the world, sound broadcasting is the more important of the two broadcasting media in terms of coverage and utilization. But in spite of radio's general availability its penetration is still lagging very much behind the world's average. In terms of statistics, Africa has only about 3 per cent of the world's number of transmitters of varying powers and on the average only about 7 per cent of its population has access to broadcasts from these urban or near-urban located transmitters. Generally, signal distribution tends to favour the urban dweller and there are very few transmitters and studio installations catering specifically for the rural areas where the bulk of the population can be found and where, ironically, the greatest need for the benefits of communication infrastructure is most evident.

The two constraints to the provision of good broadcast signals on nation-wide basis, using terrestrial transmission systems, are relatively high cost and lack of skilled manpower. There is evidence of efforts to improve skilled manpower availability at all levels. The cost (at prevailing market prices) of terrestrial broadcast engineering systems needed to effect full national coverage of any average-sized country in the region is however still prohibitive in relation to the gross national product of the country.

To improve terrestrial broadcasting as a tool for social and economic development therefore, two problems in the technical domain call for attention. These are availability of low-priced receiving facilities and low-cost and good signal-delivery systems with nation-wide coverage. The latter problem is intended to be the principal concern of this study and may be solved by the provision of low-cost systems which make use of technology suited to the needs and circumstances of the countries of the region.

Alternative technology

Sound broadcasting in the region has, in the main, tended to serve urban communities, largely because the cost of extending good quality service to rural communities can be prohibitive. These extensions of service can usually be achieved either by system expansion of the nationally centralized network or by the provision of technically independent and community-centred system capable

of being hooked-up to the national system by microwave links or off-the-air-pick-ups. Of the two modes of service extensions, the former can produce a less satisfying and effective broadcasting service because it can be largely urban-oriented and its output unrelated in the main to the needs of the rural community it purports to serve. Using current technology, extensions of service coverage by either mode can be prohibitive for most countries of the region.

To provide a community-oriented service therefore, a relatively low-cost and viable infrastructure is required. To provide this, using current professional large-scale systems and technology, has so far proved difficult, if not impossible.

The engineering and technology required for the production of broadcasting equipment need not be as costly as the largely imported ones would indicate. The experience of one or two national broadcasting organizations in the region in the design and fabrication of sound studio equipment and of the use of less complex and less costly equipment by community broadcasting institutions in some technologically advanced countries support the view that alternative technology can provide low-cost infrastructure for rural community broadcasting.

The project objective

To find alternative "low-cost" system to the imported and expensive broadcast equipment which can prove equally expansive to operate and maintain.

Strategy

This is conceived in two phases: (1) The study of some major sound broadcasting system currently in use in some countries of the region, the coverage areas in terms of the national geographical areas and population achieved by such systems and their related costs in capital and operational terms; and (2) determining the feasibility of and making recommendations on a low-cost system as an alternative to the traditional large-scale technologically more advanced (and expensive) system currently in use as well as on a national broadcasting organization which can host the fabrication and field testing of a suitable low-cost model system.

This study project is to be completed in a period of 12 months. Annex I carries the terms of reference.

Field missions

Before field missions to a number of African countries, discussions on the project were held with:

(a) ITU, Geneva: The purpose was to gather supplementary technical background information on broadcasting in the African region which might be of relevance to the project;

(b) UNIDO, Vienna to gather supplementary technical background information on broadcast equipment manufacture; and

(c) UNESCO, Paris to gather information on recent developments in rural broadcasting.

The country field mission started on 22 August 1980 with visits to the countries and interviews with the officials of the national broadcasting organizations listed below.

1. The Gambia (23 - 28 August)
   (a) Mr. S.J. Conaten, Director of Information and Broadcasting
   (b) Mr. A.D. Jobe, Chief Engineer, Radio Gambia

2. Ghana (28 August to 8 September)
   (a) Col. J. Y. Assasie, Director General, GBC
   (b) Mr. G.B. Lamptey, Ag. Director of Engineering, GBC
   (c) Mr. Y. Chang-Simpson, Ag. Deputy Director General

3. Nigeria (8 to 12 September)
   (a) Mr. George Bako, Director General, FRCN
   (b) Mr. V. Cantos, Deputy Director General, FRCN

4. The United Republic of Cameroon (12 to 19 September)
   (a) Mr. Alexandre Kokon-a-Messe, Director, R.D.C.
   (b) Mr. Emmanuel Nguiamba, Deputy Director, R.D.C.
   (c) M.M. Gottlib, Asst. Director, R.D.C.
   (d) Mr. Ayongo Ambroise, Planning Engineer

5. Kenya (19 to 28 September)
   (a) Mr. Thiongo, Chief Engineer (Radio)
   (b) Mr. Wanjan, Ag. Director, KBC

6. Ethiopia (4 to 10 October)
   (a) Mr. Gedamu Abraha, Head of Radio
   (b) Mr. Kebede Gobena, Chief Engineer, Jimma Ber Station
   (c) Mr. Tefere Gebremedhin, Asst. Chief Engineer, Jimma Ber Station

7. Uganda (10 to 18 October)
   (a) Ag. Permanent Secretary, Ministry of Information
   (b) Director of Broadcasting
   (c) Mr. T. Okello, Senior Engineer

8. United Republic of Tanzania (18 to 26 October)
   (a) Mr. Ignatius Muhumbira, Chief Engineer
   (b) Mr. Stephen Odunga, Senior Engineer (Planning)

9. Zambia (26 to 31 October)

(a) Mr. A.E. Phiri, Director General, ZBS
(b) Mr. K.K. Saddi, Ag. Chief Engineer, ZBS
(c) Mr. C. Kumwenda, Broadcast Engineer, ZBS

10. Malawi (31 October to 8 November)

(a) Mr. P.T.S. Kandiero, Managing Director, MBC
(b) Senior Engineer (Transmitters)
(c) Senior Engineer (Studios)

11. The Sudan (14 to 21 November)

(a) Mr. Mohamoud Abu Glaziem, Director-General (Radio)
(b) Mr. Ahmed Dafalla Mohammed, Senior Engineer

A visit to Swaziland scheduled to take place from the 7 to 12 November was subsequently cancelled at the request of the Government of that country.

THE GAMBIA

(Radio Gambia)

The Gambia has an area of 11,295 km^2 with a population of 584,502 evenly distributed along the Gambia River. The country stretches some 350 km eastwards from the shores of the Atlantic Ocean with the river flowing centrally along its entire length; the average width of the country is such that no point within is more than 30 km from the shores of the river. The widest stretch, 60 km, is its Atlantic shore where Banjul, the capital city, is located near the confluence of the river. The terrain is flat with the highest elevation not more than 50 m above mean sea level.

Apart from the western Atlantic coast boundary, the Gambia is completely surrounded by the Republic of Senegal.

The Gambia's economy, GNP $US 260 per capita, is based on agriculture, forestry and fishing, the most important product being groundnuts. There is also a small cotton textile industry.

Infrastructure

Radio Gambia's studios are located 11 km from Banjul, and its two transmitter stations are at Bonto, 45 km east of Banjul, and at Basse, 248 km east of the Bonto transmitter station.

The programme link between the studio centre and the Bonto transmitter station is provided by a 10 Watt, VHF, Band II, transmitter installed at the studio centre and its receiver at the Bonto transmitter station; although the transmitting antennas are directional (eastwards) the signal strength of this VHF transmission is such that owners of VHF, FM broadcast receivers in and around Banjul easily pick up the broadcasts.

Base transmitter station picks up off-air transmissions from Bonto for rebroadcast.

Studios

There are three studios with adjoining studio control cubicles.

The General Purpose Studio measuring about 8.40 m x 4.8 m adjoins a talks studio with dimensions 4.80 m x 3 m;these two studios use a common control cubicle equipped with:

- One 8-channel audio mixer;
- Two turn tables; and
- Two tape recorders.

The General Purpose Studio has been wired for use of four microphones and the talks studio two. It is obvious from this arrangement that only one of these two studios could be used at any one time.

The third studio, which is of the same dimensions as the talks studio, is the transmission studio; its control cubicle is equipped with:

- One 4-channel audio mixer;
- Two turn tables; and
- Two tape recorders.

The VHF link transmitters, and programme input equipment, and jackfied panels for selection and routing of programmes are mounted in the master control room which has dimensions 5.40 m x 4.80 m approximately. Radio Gambia broadcasts a total of 126 hours per week on two channels, the Home and the General Service.

A 50 m self supporting mast is used as a support for the VHF link Yagi antennas, one leg of the mast acts as support for a dipole antenna used for monitoring transmissions from the Bonto and Basse transmitter stations.

The Studio Centre has a 25 KVA standby diesel generator which takes over power supplies automatically in cases of mains electricity supply failure.

Transmitters

The main transmitter station, Bonto which is 45 km from Banjul, is equipped with four, 10 kw medium-wave transmitters, working in parallel operations of 2 x 10 kw; each pair thus giving a combined output of 20 kw.

The outputs of the two parallelled transmitters are fed to one mast radiator; with Bonto being almost at the western end of the country (28 km from the boundary and 285 km from the eastern boundary) the mast radiator has been provided with a mast reflector located in such a way as to beam the main signal eastwards, the intention being to cover the whole country with transmissions from the Bonto station. The best that could be achieved with this antenna configuration is a signal strength of 500 V/M, 205 km east of the station during daylight hours; the quality of the received signal deteriorates between 170 km and 230 km from the transmitting station due to nighttime fading.

In order to cover the whole country effectively, a second medium-wave transmitter station with four 1 kw transmitters having the same arrangements as those at the Bonto station, has been built at Basse, 248 km east of Bonto.

The Basse transmitter station receives the off-air medium-wave transmissions from Bonto and retransmits the signals on different frequencies. The Basse transmitter station virtually solved the problem of the country-wide coverage, so far as good daytime reception was concerned, however there still remains an area of about 950 km^2, 175 km east of Bonto that suffers from nighttime fading.

Transmitter locations, output powers and antennas

Location	Output power & type	Type of antenna
Bonto (28 km east of Banjul)	Two, 2 x 10 kw, MW	Mast Radiator with reflector Directional, west to east
Basse (248 km east of Bonto)	Two, 2 x 1 kw, MW	Mast Radiator, Non-directional
Banjul	10 Watts, VHF, FM Bank II	Yagi; directional to Bonto used as programme link.

Estimated cost of maintenance

The estimated total expenditure for operating and maintaining Radio Gambia's services works out at $US 220,455.00 per annum. The breakdown is as follows:

		In $US
(a)	Studio maintenance cost	
	Replacement of component parts	3,500.00
(b)	Transmitter maintenance cost	
	Replacement of components	38,400.00
(c)	Power supplies	82,555.00 a/
(d)	Salaries and wages of maintenance and operational staff	105,000.00 b/
	Total	229,455.00

a/ Because of unavailability of actual figures this computed amount was based on Radio Gambia's 6,552 hours operation per annum on two channels and local central electricity tariff of about $US 0.10 per kwh.

b/ Figure based on annual salaries of 30 middle grade and 10 senior technical officers. Salaries: Middle grade $ 2,500 per annum; Senior technical 30,000 per annum.

Workshop facilities

Radio Gambia's workshop, measuring 3.80 m x 4.20 m is in fact a studio equipment maintenance workshop; it is not equipped for the fabrication of the "low-cost broadcast" model equipment envisaged for the project. The station's one multimeter is always in demand by the control room and the workshop technical staff. There is also shortage of trained technical staff.

From discussions with the Permanent Secretary, the Director of Information and Broadcasting and the Chief Engineer, the Gambia would highly welcome the establishment of the "Low-Cost Broadcast System" in the country because it will solve the organizations difficulties in satisfying the various rural areas by broadcasting in the various languages spoken in these areas; furthermore project station will also be used for educational broadcasting and recording of local programmes. In addition it is hoped that the start of this project will introduce the use of VHF, FM transmission for country-wide coverage to supplement the existing medium wave transmitters.

The Permanent Secretary assured the consultant that his Government was prepared to provide all necessary assistance within it. means to make the project a success should the Gambia be chosen as one of the countries to host it.

GHANA

The Ghana Broadcasting Corporation (GBC)

Ghana, with its population of 11,317,000 and covering an area of 238,537 km^2 shares international boundary with the Upper Volta to the north, the Ivory Coast to the West, and Togo to the east; the Atlantic ocean provides the country's southern boundary.

The southern part of the country is flat with tropical savannah type of vegetation which gradually turns to hilly forested area northwards to the central part of the country. The hills range in height from a few hundred metres to nearly 1,000 m above sea level. The northern part of the country is again flat with subtropical savanna type vegetation.

Ghana's economy (GNP $US 390 per capita) is dependent on cocoa, the major export, though a wide range of agricultural products are produced. There are also a range of minerals available; the most important are gold, diamonds, manganese, bauxite, and oil. The main manufacturing industries are cement, cocoa products, food, timber products and vehicle assembly.

Infrastructure

The Ghana Broadcasting Corporation operates rural stations, locally called "relay stations" somewhat similar to the broadcast stations envisaged in the "Low-Cost Broadcasting Project".

There are about 52 of these stations in all the nine regions of the country and in a number of regional districts as well. The main difference between the project's "model station" and the GBC's "rely station" is that instead of transmitters being used to radiate the output of the "relay stations" to radio receivers, there are loudspeakers installed in various houses in the towns or villages where the stations are; and these are connected by overhead lines through transformers to high-power amplifiers located in the "relay stations".

The power outputs of these amplifiers range from 100 watts to 1,000 watts depending on the size of the towns or villages and on the number of loudspeakers the amplifiers would be required to feed.

The loudspeaker cabinet contains no active components and so no electricity or battery supplies are required for its operation; a series of resistors and a transformer are used to control and transform the incoming audio line voltage from about 60 volts to 2 volts to feed the loudspeaker. The power output of the speaker is between 0.5 to 1 watt.

The "relay station", as the name implies, relays programmes originated from the national studio centre in Accra most of the time. A broadcast communication receiver connected to a folded dipole is used in picking up transmissions from the national short-wave transmitters and the received audio

signals are fed into the high-power audio amplifiers for distribution to the loudspeakers in the various homes. Apart from relaying of programmes oriented from the national studios in Accra, locally produced and recorded programmes from the station's studios may be transported to Accra for nation-wide broadcast or used as local programmes by playing back through the "relay station's" amplifiers into the loudspeakers installed in the various homes.

The GBC is at present finding it difficult and expensive to maintain these stations because of the following reasons:

(a) The poles used in supporting the overhead lines get knocked down by vehicles resulting in breaks in the lines and occasionally lengths of the cable are stolen; in order to avoid long breaks in service as a result of these, the Corporation

(b) keeps permanent line staff (number depends on extent of line network; minimum (4) at the "relay stations" with spare line materials to carry out immediate repair work on the lines should the need arise;

(c) recent increase in the salaries and wages of the station's operational staff together with those of the linemen (in fact of all public servants in Ghana) and the granting of some fringe benefits like housing allowances have more than doubled the operational cost of the "relay station". It is estimated that it costs the GBC $US 6.71 per month to keep one loudspeaker operating in a typical rural area with 200 loudspeaker subscribers; the monthly subscription fee for a loudspeaker installed in a home (fixed by the State) is $US 1.00; apparently the income of the rural dweller is such that this difference in cost cannot be passed on to subscribers.

(d) Finally all the high-power amplifiers in use at the stations are of the thermionic valve type, these are fast becoming obsolete and so have to be replaced with solid state amplifiers in order to avoid difficulties in getting spare parts for them in future. A few of the solid state amplifiers tried on the relay lines lost their output transistors after a couple of weeks in operation due to line mismatch often caused by open or short circuits on the line thermionic valves are able to withstand such a mismatch.

The above problems make the use of low-power VHF, FM transmitters instead of amplifiers as envisaged in the project, ideal for these stations.

The Ghana Government has given its approval to the use of VHF, FM as the mode of future national broadcast transmissions, and two VHF, FM stations each having an output power of 5 kw are under construction in the upper region of Ghana. This in fact forms part of the Upper Regional Agricultural Project which is being financed jointly by the World Bank, the British Government and the Ghana Government. It is hoped that the two radio assembly plants in Ghana will soon start assembling VHF, FM receivers at reasonable prices to make the project a success.

Apart from the studios attached to the 52 "relay stations" described above, all the GBC studios, for both national and external broadcasting, are located in Accra, the capital city.

There are two short-wave transmitter stations which transmit the national programme for nation-wide coverage; one of the two stations is located in Accra, about 400 m from the GBC studio centre. The second station is at Ejura, about 370 km north of Accra, almost in the centre of the country. Unlike any of the countries visited, the GBC does not operate medium-wave transmitters.

The Accra transmitter station is linked to the studio centre by underground cable while the Ejura station is connected to the studio centre by wideland micro-wave links of the P & T Corporation.

The GBC transmitted its national programme on VHF, FM for about six years (1967 to 1973) from three transmitters co-sited with the country's three main TV transmitters at Ajangote (32 km north-east of Accra), Kissi (176 km west of Accra) and Jamasi (330 km north of Accra). All the three transmitters were linked to the studio centre in Accra by microwave. This service ceased because of spare parts problems; efforts are being made to resuccitate it.

The GBC started its External Service in 1961. The short-wave transmitters for this service are four 100 kw and two 250 kw and are respectively at Tema (29 km east of Accra) and at Ejura, same station for the national short-wave service transmitters. The Tema station is linked to the studio centre by UHF while Ejura is linked by microwave.

Studios

The GBC sound studio buildings are in the same compound as its administration and the national television studio blocks. There are altogether 13 studios for the national service which operates on two networks;GBC-1 which broadcasts mainly in the local languages and educational programmes in English GBC-2 is the main English language network; this network also carried commercial advertisements in English and in the local languages.

Eight of the 13 studios, five talks studios, two drama studios and one music studio, are used for the GBC-1 network and the remaining five, four talks studios and one drama studio,for GBC-2. The external service has six studios in number,all of which are talks or discussion studios.

Although the three networks, GBC-1, GBC-2 and the External Services, operate independent of one another, the outputs of their control rooms are wired to a central national control room, thus making it possible to use any one of the 19 studios for live broadcast on any or all the three networks.

Efforts are being made to standardize on the studio equipment in use in the 19 studios; at present there are three types of this equipment: 20-year-old imported audio mixers still in use, locally fabricated ones and relatively new (15-year-old) imported ones.

The studio control cubicles equipment are as follows:

Three GBC talks and discussion studios are each equipped with:

One-4 channel audio mixer (Marconi, 1958)
Two turn-table (Garrad, 1960)
Two tape recording machines (Ferrograph, 1960)

Four GBC-1 studios (two talks and two drama studios) are each equipped with:

One 4-channel audio mixer (locally fabricated)
Two turn-tables (Garrad, 1964)
Two tape recording machines (Ferrograph, 1964)

The GBC-1 studios) is equipped with:

One 8-channel audio mixer (two Marconi 1965, 4-channel locally paralled)
Two turn-table (EMT, 1975)
Two tape recording machines (Ferrograph 1975)

The GBC-2 drama studio uses a 8-channel Marconi 1965 audio mixer, otherwise the studio equipment are the same as the four talks studios except for the absence of cassette record/reproducers. The four talk studios are equipped with:

One 4-channel audio mixer (Marconi 1965)
Two turn-table (Garrad, 1965)
Two tape recording machines (Ferrograph, 1965)

The six External Service studios are equipped with:

One 4-channel audio mixer (locally fabricated)
Two turn-tables (EMT 1975 or Garrad 1965)
Two tape recording machines (Studer console 1975 or Ferrograph 1965)

In addition to the above facilities, there are four tape recording channels wired to the central national control room; each channel is equipped with two console type Ampex (1960) tape recorders with their associated switching

All the three control rooms (GBC-1, GBC-2 and External) are similarly equipped; three or four bays of equipment racks house jackfield socket panels for programme routing, programme distribution amplifiers and and audio monitoring equipment.

Unlike the other two networks, GBC-1 has a continuity announcers studio, equipped with two turn-table and one tape recording machine to ensure smooth changeover in local language broadcasts.

The multiplicity of equipment and their age does not make the work of the operational and maintenance staff easy, breakdowns of service due either to mal-operation or equipment breakdown are fairly common.

Transmitters

The GBC uses shortwaves for its national broadcast coverage; VHF, FM mode of transmission has been successfully tried in some parts of the country and the Corporation hopes to change over to this new mode of transmission in future. Medium wave has never been tried and it is not likely, compared with the lower cost of operation and other advantages of VHF, FM broadcast, that the GBC will ever introduce medium-wave broadcast in the country.

Apart from its advantage of country-wide coverage from one or possibly two transmitter stations, the quality of reception of short-wave transmissions, immediately outside the vicinity of the transmitter, is poor compared with either of the two other modes of transmission, i.e., medium wave and VHF, FM when used for national broadcast. The GBC national broadcasts thus suffer from deep fadings of the broadcast signals in certain parts of the country as well as the existence of skip zones in some parts of the country. Some listeners in Ghana's neighbouring countries report good clear signals whereas listeners in parts of Ghana, for whom the signals are intended, report not receiving the transmissions at all.

Transmitter stations, output power and types of antenna

Location	Output power and type	Type of antenna
Accra	20 kW, SW (out of service)	Folded dipoles and quadrants near vertical incidence
"	10 kW, SW	"
"	10 kW, SW	"
Ejura (370 km North of Accra)	Three, 2 x 10 kW, SW 2 of 250 kw, SW	Folded dipoles Vertically stacked horizontal dipole array, HRS/4/4/h
Tema	4 of 100 kW, SW	"
(30 km north-east of Accra)	1 kW, VHF, FM(out of service)	Non directional
Kissi (176 km west of Accra)	1 kW, VHF, FM (out of service)	"
Jamasi (330 km north of Accra)	5 kW, VHF, FM (out of service)	"
Under construction		
Bolgatanga (800 km north of Accra)	5 kW, VHF, FM	Vertically polarized
Han (80 km west of Bolgatanga)	5 kW, VHF, FM	"

The three VHF, FM transmitters at Ajangote, Kissi and Jamasi covered about 30 per cent of the country and 40 per cent of the population when in operation as against 80 per cent of the country and some 90 per cent of the population covered by the short-wave national transmitters. As stated earlier, reception of the short-wave national transmission suffers from ionospheric fadings and skip zones exist in some parts of the country whereas the VHF, FM transmissions gave relatively good and better quality reception when in service.

Estimated cost of maintenance and operation

The annual estimated cost to the GBC for operating and maintaining its services comes to about $US 1,831,400 including the cost of maintaining the 52 "relay stations" at $US 139,568 per annum. Below is the breakdown:

		In $US
(a)	Studio maintenance cost	
	Replacement of component parts	23,600
(b)	Transmitter maintenance cost	
	Replacement of component parts	506,400
(c)	Power supplies	792,188
(d)	Salaries and wages of maintenance and operational staff	369,600
(e)	"Relay stations"	139,568
	Total	1,831,356

According to the GBC, the three VHF, FM transmitters when in operation was costing only about $US 12,000 per annum to operate and maintain while the national short-wave transmitters were costing about $US 40,000.

Workshop facilities and the "low cost" broadcast system in Ghana

Apart from studio maintenance workshops, the GBC has a fairly large workshop (10.6 m x 6 m) for fabricating equipment required for use in new "relay stations" or in the GBC studios, centrally placed in the workshop is a bench which is wired for either testing newly fabricated equipment or for carrying out modification work on old equipment; actual wiring of components is done on smaller benches at one end of the wall. This central workshop can easily accommodate up to 15 technicians actively engaged in wiring of new equipment for testing.

Adjoining this workshop is a machine workshop where sheet metals are cut, bent or drilled into chassis for various equipment.

The GBC has adequate test equipment like audio signal generators, test meters and oscilloscopes to undertake the fabrication and field testing of the model but the country's present economy is such that it has become rather difficult to get certain fabrication materials like resistors, capacitors, etc, that might be needed locally during the course of fabrication.

The GBC management however expressed the willingness of the Corporation to play any part it might be called upon to play in the implementation of the project. They suggested Mankesim, a market town, 90 km west of Accra, as possible site for the project; it is hoped that this site will be linked up with the Accra-based VHF, FM transmitter when it is repaired. In fact, any of the district "relay stations" can provide a suitable site for field testing and possible permanent site for the model system.

NIGERIA

The Federal Radio Corporation of Nigeria

The Federal Republic of Nigeria is made up of 19 semi-autonomous states with a total population of about 79 million covering an area of 923,768 km^2.

Nigeria shares international boundaries with the Niger to the north, the United Republic of Cameroon to the east and Benin to the west; the Atlantic Ocean forms the southern boundary of the country.

The northern part of the country is generally hilly with areas in the Bauchi Plateau and around Jos rising to about 1,500 m above sea level. Most of the southern parts especially around the Niger River are flat lowlands, thickly forrested. The coastal lowlands are marked with lagoons and creeks especially around the delta of the Niger River.

Nigeria (GNP $US 560) is one of the major oil producers in Africa; natural gas is also an important resource. Agriculture is still important and there is a thriving timber industry in the south, with cattle farming predominant in the north. Hydroelectric power is produced from the Niger River, particularly the Kainji Dams. The southwest has the most fertile arable land and produces cocoa, rubber and timber; the southeast is the main area of palm oil production.

Interviews and discussions with the Director-General and the Director of Technical Services of the Federal Radio Corporation of Nigeria took place on Monday, 8 September 1980. The consultant was informed during the discussions that the Director-General and a number of the FRCN members of management would be leaving Nigeria on Friday, 12 September 1980 to attend a Commonwealth Broadcasting Association Conference opening on Saturday, 13 September 1980 in Australia and so most of the top executives were away from their offices in preparation for the travel.

It was gathered from the discussions that sound broadcasting in Nigeria, formerly the responsibility of the erstwhile Nigerian Broadcasting Corporation, is now the responsibility of the Federal Radio Corporation of Nigeria (FRCN) and the 19 state radios in the country.

The FRCN is the official broadcasting organization of the Federal Government of Nigeria and is also the only organization responsible for nation-wide and external broadcasting in Nigeria, in addition to the external service, the FRCN has four semi-autonomous zonal stations - FRCN (Kaduna), FRCN (Ibadan), FRCN (Enugu) and FRCN (Lagos). Each zonal station has its own studio-transmitter complex and is expected to broadcast to the people in the zone it covers, and in the languages understood by the people in that zone. One of the main objectives of the FRCN is the promotion of national unity by ensuring balanced presentation of views from all parts of the country.

The state radios are under the control of the individual state governments. Federal regulation forbids the use of transmitters whose radiated field strength will be in excess of 1 MV at the state boundary; this in a way forbids the use of transmitters with more than 10 kw output power by any of the 19 states. The responsibilities of the state radios are to promote social and cultural activities within the states and communicate to the people in the states in their various languages; thus whereas an FRCN zonal station might be broadcasting three or four of the various languages of the states that make up the zone, the state radio is expected to cover all the languages spoken in that particular state, The state radio is in fact expected to cater for the rural dweller. With the imposed limit of 1 millivolt/m at the state boundaries, some states find it difficult to effectively cover certain areas of poor reception by increasing transmitter output power; some of these states are considering the use of low-power VHF, FM transmitters in their areas of poor reception.

From the above, it becomes clear that the organizations that should be contacted for information, according to the consultant's terms of reference and the objectives of the project, are the 19 state broadcasting corporations.

The Managing Director of Lagos State Broadcasting Corporation was contacted on Wednesday, 10 September 1980 but discussions could not take place as the Managing Director was preparing to attend a Board Meeting that day. An appointment was made to meet the next day, 11 September, but this too could not come on as the Managing Director could not be contacted.

The consultant had to leave for the United Republic of Cameroon on Friday, 12 September, without getting the required information on any of the Nigerian broadcasting organizations.

THE UNITED REPUBLIC OF CAMEROON

Radiodiffusion du Cameroun, (RDC)

The United Republic of Cameroon has a population of 8,248,000 and an area of 475,442 km^2. It is bordered by Chad to the north-east, the Central African Republic to the west and the Congo and Gabon to the south. Nigeria and the Atlantic Ocean form the western border.

Apart from the coastal lowlands where Mt. Cameroon (4,000 m above sea level) is located, the whole country is generally mountainous and heavily forested.

The country's economy (GNP $US 460) is based on agriculture, the main export crops being cocoa and coffee; maize, bananas and yams are also grown; cattle, sheep and goats are kept in large numbers, and fishing takes place on the rivers and the coast. The country's industries include timber, aluminium refining, chemical manufacture, furniture and textile making. Large deposits of gold and bauxite have been found and are just beginning to be exploited.

Although the consultant arrived at Yaounde on Sunday, 14 September 1980, interviews and discussions with the authorities of Radiodiffusion du Cameroun could not take place until 10.30 a.m. on Tuesday, 16 September. The RDC engineer who was assigned to the consultant as a result of the first day's interview with the Directorate reported the loss of his uncle on Wednesday, 17 September; requests to replace the engineer could not be met due to shortage of engineers and it was finally decided that the required information on RDC should be mailed to the consultant later. Because of the above, the consultant was not shown round RDC's studios and other installations.

This report is therefore based on the interviews and discussions with the authorities of the RDC and on the information received later on by post from the RDC.

The authorities of the Radiodiffusion du Cameroun showed keen interest in the "Low Cost Broadcasting Project" because they found the project a possible solution to their problem of having to cater for over 60 local languages in their national broadcast programmes. At present this problem has been partly solved by the establishment of semi-autonomous broadcasting stations in the country's seven main provinces; these provincial broadcast stations are located at Yaounde, the capital city, Buea, Douala, Garoua, Bertoua, Bafoussam and Bamenda. In addition to the transmissions from these provincial stations, the whole country is covered by transmissions from the national short-wave transmitters located at Yaounde. The transmitters for the South-Central Province are also located at Yaounde.

Infrastructure

A new broadcasting headquarters at Yaounde houses the studios of the National Service; in all there are nine studios - two music/drama studios and seven talks studio. The Yaounde based South-Central Provincial Station has five studios; those at Garoua (Northern Province), Bertoua (Eastern Province) and Bafoussam (North-West) has three studios each; Buea (South-West) and Douala (Coastal Province) have two studios each.

All the provincial stations are required to relay the hourly news in English and French and some special national programmes as and when requested by headquarters, otherwise these stations broadcast programme originating from their studios and in the principal languages spoken in the provinces.

The RDC, Yaounde, broadcasts programmes in only French and English on the National Service for the whole country. To increase its coverage area and also as a means of catering for the many languages, the RDC uses, a "mobile broadcast station" equipped with a low-power, 250 watt SW transmitter; this "mobile station" is sent to rural areas during their annual festivals or during important local activities for recordings, relaying of news from the National Service in addition to broadcasting in the languages spoken in the area.

Studios

(No information on studio equipment)

Transmitters

The RDC uses both medium and short-wave transmission for its national coverage. Apart from two provincial transmitter stations (Douala and Bamenda), all the other stations have both short-wave and medium-wave transmitters transmitting simultaneously. This is to ensure reception outside the radius of coverage of the medium-wave transmitters.

Yaounde and Douala transmit on VHF, FM from 50-watt transmitters for residents in and around the two towns.

As stated earlier there is a "mobile stations" used in recording and broadcasting activities taking place in rural areas is equipped with a 250-watt short-wave transmitter.

Transmitter stations, output powers and types of antenna

Location	Output power and type	Antenna
Yaounde (South-Central Province)	2 of 100 kw, SW (national service)	Dipole non-directional
	20 kw, MW (national service)	Radiating mast. Non-directional
	100 kw, SW (external service)	Vertically stack, horizontal Dipole array. Directional

Location	Output power and type	Antenna
Yaounde	2 of 30 kw, SW (provincial service)	Dipole non-directional
	2 of x 5 kw, MW "	" " "
	2 of 4 kw, SW "	" " "
	1 kw, MW "	" " "
	50 watts, VHF, FM (local)	Yagi
Buea (260 km west of Yaounde South-West Province)	2 x 4 kw, SW (provincial ser.)	Dipole non-directional
	4 kw, SW " "	
Douala (200 km west of Yaounde Coastal Province)	2 x 5 kw, MW (provincial ser.)	'T' antenna non-directional
	50 watts VHF, FM (local)	
Garoua (620 km north of Yaounde Northern Province)	2 of 100 kw SW (provincial service)	Dipole bi-directional Bi-directional dipole
	2 of 4 kw. SW "	Bi-directional dipole
	20 kw, MW "	Non-directional mast radiator,
	1 kw, MW "	'T' antenna
Bertoua (240 km east of Yaounde Eastern Province)	2 of 20 kw, SW "	Dipole non-directional
	20 kw, MW "	'T' antenna
Bafoussam (200 km, north west of Yaounde) (North-West Province)	2 of 20 kw, SW "	Dipole, non-directional
	20 kw, MW "	'T' antenna
Bamenda (290 km north west of Yaounde) (North-West Province)	2 of 1 kw, MW "	'T' Antenna non-directional
Mobile station's transmitter, output power, 250 watts, short-wave;		Output Bi-directional, Dipole

Estimated cost maintenance and operation

Although the RDC has stated 150,000,000 CFA francs ($US 789,470) per annum as the cost of maintaining the above service (excluding staff salaries), it is felt that this figure is on the low side; the cost of maintaining the Gambia's installation of three studios and two transmitter stations (total output power 44 kw) excluding staff salaries is $US 374,695 yet the Gambia's total installations are less than one-tenth that of the RDC.

Estimates based on the RDC's 27 studios and 469 kw daily total transmitter power output and 4284 transmission hours gave the following figures as the annual expenditure:

		In $US
(a)	Studio maintenance cost	
	Replacement of component parts	25,000
(b)	Transmitter maintenance cost	
	Replacement of component parts	473,000
(c)	Cost of power supplies	744,000
(d)	Salaries and wages of maintenance and operational staff	243,000
	Total	1,485,000

Workshop facilities and the "Low-Cost Broadcast System" in the United Republic of Cameroon

The RDC has adequate workshop facilities to undertake fabrication work involving audio test. Instruments like signal generators, frequency meters and multimeters are available; there are not enough test instruments in the VHF range since the RDC has only recently started using VHF for transmission. It hopes however to acquire more VHF test instruments shortly since it has been planned to establish more VHF, FM broadcast stations in the districts. The technicians are not familiar with wiring printed circuit boards but this should not pose any major problem should the United Republic of Cameroon be selected as a host country.

The "Low-Cost Sound Broadcasting Project" is in line with the thinking of the RDC in its plan to establish a number of low-power VHF, FM broadcast stations in the districts; apart from relaying the national news and other special programmes from the national service, these stations will broadcast programmes on agriculture, education and health in the local languages. At present it is planned to acquire two more of the "mobile stations" to be used for these extension work until the fixed district stations come into operation.

With the successful operation of the 50 watt VHF, FM stations at Yaounde and Douala, it is the intention of the RDC to co-site more powerful VHF, FM transmitters with the television transmitters in the proposed country-wide television network. "In this way we hope to improve the quality of reception of our programmes which are currently being broadcast through our AM transmission network" wrote the Director in his letter dated 18 October 1980.

KENYA

The Voice of Kenya VOK

The East African State of Kenya lies between Ethiopia and the United Republic of Tanzania to the north and south respectively; it shares its western border with Uganda and about 70 per cent of its eastern border with Somalia; the Indian Ocean forms the remaining 30 per cent of the country's eastern border.

The country covers an area of about 582,644 km^2 with a population of 15,320,000. It is generally mountainous with Nairobi, the capital city lying some 1,500 m above sea level; about 65 per cent of the country is more than 1000 m above sea level, the remaining 35 per cent lowlands are in the Bun plains near the border with Somalia and in the Ngangerabili plains near the shores of the Indian Ocean. The highlands are dotted with lakes and mountains; Lake Rudolf, the largest lake has its northern shores along the Ethiopian border; the border line with Uganda crosses the western tip of Lake Victoria. The highest mountain is Mount Kenya, about 5,200 m high.

Kenya's GNP is $US 360 and its main exports are coffee, tea, cement, meat, meat products and pyrethrum; its mineral resources are copper, gold and gypsum. Tourism, one of the major economic activities in Kenya, has also brought much of the fame that the country enjoys internationally, other industries are vehicle assembling, textiles and plastics.

The consultant arrived in Kenya on 22 September 1980 when most of the top executives of the Voice of Kenya were away attending a conference in Australia; it therefore became difficult to arrange any meaningful programme of visits in connexion with the mission. Discussions also suffered due to the absence of these top executives.

This report is therefore mainly on VOK transmitters (no visits to transmitters stations) and on a brief visit to the Kenya Institute of Mass Communication (KIMG).

Infrastructure

The headquarters and studio centre (radio and television)of the VOK are housed in the same building, located about 2 km from the centre of Nairobi. The national transmitters which are short-wave, medium-wave and VHF, FM are located mainly in the southern parts of the country.

The northern part of the country is served mainly by the short-wave transmitters located near Nairobi and also by night-time propagated medium-wave signals from the Nairobi-located medium-wave transmitters.

There are extensive VOK programme links covering all the important towns in the country and that is virtually the whole country.

These links enable local programmes from different parts of the country to be piped down to the studio centre in Nairobi either for recording or live broadcast.

There are plans to extend the VHF, FM service to cover the whole country within the next five years. With the already existence of good country-wide programme link such an extension should not present too many difficulties.

Transmitters

The VOK's three main programme channels - the National Service, the General Service and the Central Vernacular Service are at present being radiated from four transmitter stations, two (medium and short wave) near Nairobi and from another two medium-wave stations near Kisumu and Mombasa. The power output of the transmitters range from 10 kw to 100 kw and there are plans to upgrade the power outputs of some of the lower power transmitter stations and also put up new stations.

Transmitters

Location	Output power and type	Antenna
Ngong (near Nairobi)	10 kw, MW, National service	Mast radiator non-directional
Nairobi	100 kw, MW, General service	" " "
	100 kw, SW, National service	Dipole
	10 kw, SW, General service	"
	10 kw, SW, General Vernacular	"
Nandi Hills (near Kisumu)	20 kw, MW, National service	Mast radiator, non-directional
	20 kw, MW, General service	" " "
Nyali (near Mombasa)	20 kw, MW, National service	" " "
	20 kw, MW, General service	" " "

Proposed new medium-wave stations

Location	Output power and type	Antenna
Kisumu (250 km west of Nairobi)	100 kw, MW, National service	Mast radiator non-directional
	100 kw, MW, General service	" " "
Meru (165 km NE of Nairobi)	100 kw, MW, National service	" " "
	100 kw, MW, General service	" " "
Voi (300 km SE of Nairobi)	100 kw, MW, National service	" " "
	100 kw, MW, General service	" " "
Garissa (330 km NE of Nairobi)	40 kw, MW, General service	" " "
	40 kw, MW, General service	" " "
Nyeri (90 km north of Nairobi)	40 kw, MW, National service	" " "
	40 kw, MW, General service	" " "
Nakuru (135 km NW of Nairobi)	40 kw, MW, National service	" " "
	40 kw, MW, National service	" " "

New VHF, FM Stations-Immediate

Location	Output power and type	Antenna
Nairobi (Hillcrest)	10 kw, VHF, Nat. & Gen. Ser.	Non-directional
Timboroa (near Kisumu)	10 kw, VHF, " " " "	" "
Nyeri (90 km north of Nairobi)	10 kw, VHF, " " " "	" "

Projected plans - expansion of transmitter network

The VOK has divided its transmitter (VHF, FM) network expansion programme into two phases. During phase I, 19 new stations in addition to the three listed above will be constructed; these stations are to be located in all regions of the country. They will be sited in towns like Moyale near the northern border with Ethiopia and Mazeras near the southern border with the United Republic of Tanzania.

Phase II will complete the desired nation-wide coverage envisaged with the construction of eight additional stations. Locations will include towns like Mandera, near the north-east border with Somalia and Lokichokio near the north-western border with the Sudan.

Present and future national coverage

The population distribution of Kenya is such that although its medium-wave transmitters in operation at present cover only some 20 per cent of the country, about 50 per cent of the population is adequately covered. With the commissioning of the six new medium-wave transmitters about 50 per cent of the country and 70 per cent of the population should receive good signals from medium-wave transmitters.

The proposed three 10 kw, VHF, FM transmitters will definitely give good quality 24-hour service within most of the areas at present being covered by medium-wave transmission.

Completion of the national VHF, FM coverage programme, Phase I and II, will not only provide 90 per cent broadcast coverage for the country but also ensure good quality signals to listeners at all hours of broadcast.

Estimated cost of maintenance and operation

Based on the transmitters in use at present and with 18 transmission hours a day for the National Service, 12 for the General Service and eight for the Central Vernacular programme, it is estimated that the VOK spends at least $US 1,204,000 per annum to operate and maintain its transmitters and studios complex (assumes a minimum of three studios in use simultaneously for the three services).

The breakdown is as follows:	In $US
(a) Cost of power supplies (mainly transmitters	678,980
(b) Maintenance cost (transmitters and studios) (replacement of component parts)	273,000
(c) Salaries and wages of maintenance and operational staff	252,000
Total	1,203,980

Cost of personnel and administrative services have not been included.

Workshop facilities and the "Low Cost Broadcast Project" in Kenya

The VOK workshop is mainly for the maintenance of its studio equipment. The workshop is very well equipped for this maintenance work with modern test equipment ranging from audio to high frequency oscillators, frequency counters and sensitive oscilloscopes. It is mainly used for servicing equipment that cannot be repaired on site (i.e., in the studios or control rooms).

There is no workshop for purely fabrication work. The VOK is of the opinion that even if it had one, there would be no technical staff to man it because the organization has of late been losing trained technical staff to newly established electronic firms in Kenya.

The Kenya Institute of Mass Communication is a department under the Ministry of Information and Broadcasting set up (in 1968) primarily to train personnel in all grades and disciplines (technical, production and operation) of mass communications.

The KIMC has over the years expanded and developed in such a way that it now produces and records radio and television programmes from its well-equipped studios for use by the VOK.

The technical training facilities of the Institute include a number of electronic laboratories and workshops designed for various electronic work fabrication of simple electronic equipment, testing of electronic equipment, electrical and electronic measurements. There are also facilities for metal work and carpentry.

Most of the technical equipment (expensive studio and television equipment) are donations from foreign governments and from United Nations agencies. The KIMC has got all the technical facilities necessary for the on-site fabrication of the studio equipment required for the "Low Cost Sound Broadcasting System" should Kenya be selected as host country for the project.

Future plans

As stated earlier, the VOK is embarking on a country-wide broadcast coverage with VHF, FM transmission in addition to improving on its present medium-wave broadcast.

The three 10 kw VHF, FM transmitters to be comissioned soon as a start of the broadcast expansion project, is a very bold step considering the fact that there are not many VHF, FM radio receivers in the country at present; but the VOK's reasoning is that with good quality signals which are free from the interferences which short and medium-wave broadcasts are subjected to, public demand for the receivers will gradually increase and local radio assembly plants will embark on the production of the receivers to meet the demand.

Technically, the VOK is interested in the "Low Cost Sound Broadcasting Project" because the project uses VHF, FM as its mode of transmission and also it appears to fall in line with the organization's plans to build a number of VHF, FM stations in various parts of the country.

The town of Malindi (about 100 km north of Mombasa), noted for its fishing industry, has been suggested as a possible site for the project but the final choice, according to the VOK, rests with the Kenya Government.

ETHIOPIA

Voice of Revolutionary Ethiopia VORE)

Ethiopia covers an area of 1,221,900 km^2 with a population of 30,420,000.

The country is bordered by the Sudan to the west, Somalia and Kenya to the east and south respectively, with the Red Sea forming the country's northern boundary.

Ethiopia is generally mountainous with peaks rising to some 5,000 m above sea level; the capital city, Addis Ababa, is about 2,500 m above sea level.

Annual rainfall is between 100 mm and 150 mm in the highlands reducing to about 35 cm in the lowland areas near the borders with the Sudan and Somalia.

Livestock and crop farming form the basis of the country's economy; the GNP is $US 120 and the main exports are coffee, hides and skins.

Infrastructure

The Voice of Revolutionary Ethiopia (VORE) comprises what was before the country's 1976 revolution, the Radio Voice of the Gospel international broadcasting station and the country's own national broadcasting station.

The VORE's studios are therefore not housed in one central block as obtains in most of the African broadcasting organizations visited.

Two of the three studio centres are sited on different locations in Addis Ababa and the third, the former Radio Voice of the Gospel's main studio centre, is located about 10 km from Addis Ababa.

The VORE has four transmitter stations, one short-wave station located about 40 km outside Addis Ababa, and another short/medium-wave station about 10 km farther away from the first one; and two regional transmitter stations located at Asmara in the northern region and at Harrar in the eastern region.

The former Radio Voice of the Gospel studio centre (known as Jimma Ber studio) is linked with the kilometre-forty short-wave transmitter station (known as Gedja Jewe transmitter station) by VHF, while the bigger of the two Addis Ababa-based studio centres (the National Studios) is linked by P & T VHF link to both the Gedja Jewe transmitter station and the nearby short/medium-wave transmitter station (known as the Gedja Derra transmitter station).

The other Addis Ababa-based studio centre, the east studio centre, is used for production only.

The MW transmitters at Asmara and Harrar are connected by P & T microwave link to the national studio centre in Addis Ababa. There are studio facilities at these two stations.

Studios

The Jimma Ber studios are housed in the former Radio Voice of the Gospel administration block, 10 km outside Addis Ababa.

There are six main studios: one drama, one music and four talks studios with associated control cubicles and a master control room. The studios are so arranged that the drama studio shares the same control cubicle with one of the talks studio, the music studio also shares a control cubicle with a talks studio while the remaining two talks studios have separate control cubicles. The music and drama studio control cubicles equipment are the same, i.e.

One 10-channel mixer;
Three tape recorders (Ampex Gonsole Type); and
Two turntables.

Each of the remaining two talks studios' control cubicles is equipped with:

One 8-channel mixer;
Two tape recorders (Ampex Console Type); and
Two turntables.

The master control room houses the jackfied panels for the studio outputs as well as the source selection and routing switches, the programme link equipment to the transmitter station and the centre's radio telephone equipment are also housed in the control room.

The national studio centre is in Addis Ababa. The centre is linked by VHF to both the Gedja Jewe short-wave transmitter station and the Gedja Derra short/medium-wave transmitter station through the Telecommunication Department network.

There are in all six studios each having its own control cubicle with:

One 8-channel mixer;
Two tape recorders (table models); and
Two turntables.

The outputs of the six studios terminate in the control room from where programmes are routed to the four transmitters in the country.

Although almost all the studio equipment in use at the Centre appear to be 15 to 20 years old, it could be observed that every effort is being made to keep them operating as efficiently as could be managed.

The east studio is used as a production studio centre for both the national studio centre and the Jimma Ber studios. It has three discussions studios equipped with recording and editing facilities, the studios are not linked directly by programme lines with the other two studios (Jimma Ber and the national studios), records materials on tape are sent by hand to the national and the Jimma Ber studios for broadcasting.

Each of the three discussion studios is equipped with:

One 8-channel mixer; and
Two tape recorders (Ampex table model)
Tape editing is done in one room adjoining the studios

The location of the east studio, almost in the centre of the city, makes it ideal for interviewing important personalities that happen to be in the city.

Transmitters

The VORE operates two services, the National and the International Services.

The National Service broadcasts daily programmes in four local languages and English on both short and medium wave.

The International Service is on short wave but medium-wave transmitters are used for broadcasting to neighbouring countries like Somalia and the Sudan.

The Gedja Jewe short-wave transmitter station is the oldest of the VORE four transmitter stations although the station has been in operation since 1964, the two 100-kw transmitters are surprisingly still in good operational condition with a fairly good stock of essential spare parts at the station.

Originally designed for 24-hour service, Gedja Jewe's operations have at present been reduced to six hours daily broadcast in the external service and about the same period broadcasting in the national service.

The Gedja Derra station is newer (built in 1971). The station houses both short-wave (100 kw) and medium-wave (100 kw) transmitters; it uses quadrants and rotatable log periodic antennas for the short-wave transmission and mast radiator for the medium wave.

The VORE has embarked on regionalization of its studios and transmitters. One 100-kw medium-wave station with studio facilities has been put up at Harrar in the eastern region and the 1 kw medium-wave station at Asmara has been upgraded to 50 kw and studio facilities have been added.

In all the VORE broadcasts a total of 152 hours, 30 minutes a week on both the National and International Services from the under-mentioned transmitters.

Location of transmitters	Power output	Antenna
Addis Ababa (Gedja Jewe)	100 kw, SW, (Ext)	Horizontal Dipole Array, HRS 4/4
" " " "	100 kw, SW, (Nat)	Quadrant
" " (" Derra)	100 kw, SW, (Nat)	Quadrant
	100 kw, SW, (Ext)	Log periodic (rotatable)
	100 kw, MW, (Nat)	Mast radiator
	2 of 10 kw, SW (not in use	Folded Dipole
	2 of 1 kw, MW (not in use)	" "

Location of transmitters	Power output	Antenna
Addis Ababa (Jimma Ber)	1 kw, MW (Nat)	'T' Antenna
Harrar (eastern region)	100 kw, MW (Nat)	Mast radiator
Asmara (northern region)	50 kw, MW (Nat)	Mast radiator
	1 kw, MW (Nat, standby)	'T' Antenna

There are plans to put up medium-wave stations of 100 kw output power with studio facilities at each of the following places:

Dessie in the north-eastern region,
Arba Minch in the southern region,
Metu in the western region.
Baher Dar in the -western region, and
El Kerre in the southern region.

Estimated cost of maintenance and operation

With actual transmitting hours of 112.5 per week for its National Service and 42 hours per week for its External Service using both short- and medium-wave transmitters for the National Service and only short-wave transmitters for the External Service, it is estimated that the VORE spends $US 1,010,000 per year to operate and maintain its transmitter and studio complex.

The breakdown is as follows:	In $US
(a) Cost of power supplies	370,000
(b) Transmitter spares	300,000
(c) High power transmitter antenna spares	50,000
(d) Studio equipment spares	80,000
(e) Salaries and wages of transmitter and studio operational staff	210,000
Total	1,010,000

The high cost of antenna maintenance is due to the fact that the short-wave curtain arrays at the Jimma Ber station are not fully used and so, according to the station Chief Engineer, the insulators and mast guy ropes damage quicker than when they were being used almost 24 hours a day.

Workshop facilities and the "Low Cost Broadcast Project" in Ethiopia

There is a fairly large workshop (2.5 m x 7 m) at the national studio centre for servicing faulty studio equipment. The workshop gives the impression of being a very busy one considering the number of broken-down equipment on benches awaiting repairs. Although the consultant was not shown the test instruments available for the workshop, a couple of audio signal generators being used at the time of the visit appeared old, near obsolete valve types which would not prove accurate enough for solid state electronics work. Moreover the ventilation in the workshop itself needs to be improved upon.

The two workshops at the Jimma Ber studios, on the other hand, should prove ideal for any electronics fabrication work. Each measuring about 3 m by 5 mm the workshops have attached to each of them a store containing hand tools and various electronics components. In addition there is a central store housing fairly modern test instruments like Hewlett-Packard electronic voltmeters, oscilloscopes of various sensitivities, etc. Some of the test instruments, according to information received, were ordered in "kit form" and built at the station. Although the present working conditions of these test instruments were not made known to the consultant there could not have been anything seriously wrong with them.

It is being recommended that Jimma Ber be used for the fabrication of the "Low-Cost Broadcasting" studio equipment should Ethiopia be considered as host country.

Reaction of VORE to the "Low Cost Broadcasting Project"

The VORE welcomed the project, especially the rural educational aspect of the programme; the Government has embarked on a country-wide literacy drive, and a rural broadcasting station like the one the project aims at will be of great assistance to the State. They however feel that it might be difficult to cover some selected areas adequately with VHF, FM transmission because of the mountainous nature of the country.

UGANDA

The Uganda Broadcasting Corporation (UBC)

Land-locked Uganda is bordered by the Sudan and the United Republic of Tanzania to the north and south respectively, by Zaire to the west and Kenya to the east. The country is generally flat (on the average between 300 and 600 m above sea level) with a tropical savanna type of vegetation; its population is 13,224,900 and it covers an area of 236,036 km^2.

The main exports are coffee, tea, cotton, hides and skins; copper and alloys (unwrought) are mined on a limited scale.

Uganda has a GNP of $US 280 and its main imports are fuel and lubricants, manufactured goods, machinery and transport equipment.

Infrastructure

The Uganda Broadcasting Corporation's 10 transmission and 13 recording studios are housed in a modern six-story radio programme production block located just outside the commercial area of Kampala. All the radio production and some of the engineering and technical staff have their offices in this block. The Director of Broadcasting, the Director of Engineering and other top executives of the Corporation are in the Ministry of Information and Broadcasting buildings about 500 m away from the radio production block.

The UBC uses mainly medium-wave transmitters for its national broadcast. There is one short-wave transmitter station (20 kw) near Kampala, the capital city, being used in addition to the medium-wave transmitters for national coverage.

There are altogether nine transmitter stations including the UBC's high-power external short-wave transmitter station at Soroti, about 200 km northeast of Kampala. Two of the eight national transmitter stations, the Bugolobi short/medium-wave station and the Kibira Road medium-wave station, are located near Kampala; the remaining six, all medium-wave stations are located in various parts of the country. These stations are either linked by P & T microwave or by the UBC's VHF and UHF links to the studio centre in Kampala.

The UBC hopes to put back on the air the Gilgili Station, destroyed during the 1978 war, and build three more 50 kw medium-wave stations at Kangole (320 km northeast of Kampala), Hoima (190 km northwest of Kampala) and Mukunya (230 km west of Kampala).

Studios

The UBC's Kampala studio centre consists of 10 transmission studios and 13 recording studios. The transmission studios are of the same dimension (3.3 m x 4.6 m) and their adjoining control cubicles are similarly equipped.

Originally there were only five transmission studios but prior to the 1976 African Heads of State and Government conference in Kampala, it became necessary to increase the number of studios to make it possible for as many as 10 programmes to be broadcast from the centre at any time.

Seven of the 13 recording studios are of the same dimensions as the transmission studios; the other six are larger (5.5 m x 7.8 m) and are meant for drama or music production. Only one of the six larger studios is equipped for production work.

Transmission studio equipment

One 4-channel mixer;
Two turntables; and
Two tape recorders (tale models).

Recording studio equipment

One 8-channel mixer;
Two turntables; and
Two tape recorders (table model).

All the larger drama or music studio are supposed to have similar studio equipment as the other recording studios, but as stated earlier only one was so equipped at the time of visit.

All the transmitter stations, except the two near Kampala, i.e. Bugolobi and Kibira Road, have emergency studios attached to them; each transmitter station studio is equipped with a four-channel mixer and one turntable.

There is one control room for both the National and the External Services. The outputs from the transmission studios and the inputs to the radio links feeding the various transmitters are terminated on jackfield panels mounted on equipment racks; programme routing is done by interconnecting the appropriate jackfield sockets.

At the time of the visit, the Kampala studio centre was in a rather poor state. Equipment were lying around studio floors with parts like transformers removed; in one or two studios loudspeakers had been removed from their cabinets; the station staff attributed all this to the 1978 war; funds had not been available for replacement, they said. The only drama/music which had been equipped for broadcasting could not be used because of poor air conditioning. The most pathetic sight was the control room - equipment wiring had not been completed since 1975, when the equipment were delivered, because of lack of instruction manuals and interconnecting cables.

Transmitters

The UBC broadcasts a total of 110 hours per week; the programme is fed by a 20 watt VHF (Band II) transmitter as well as landline to the two transmitter stations near Kampala and by VHF and P & T microwave link to the other transmitters in the country.

Below are the locations of the transmitters their power output and the antenna system in use.

Location	Power output	Antenna system
Kampala (Bugolobi)	2 of 7.5 kw, SW	Dipole, non-directional
	20 kw, SW	Log periodic
	1 kw, MW	'T' antenna
Kampala (Kibira Road)	10 kw, MW	Mast radiator, non-directional
Mawaga (60 km west of Kampala)	100 kw, MW	Mast radiator, non-directional
Kabale (340 km, SW of Kampala)	100 kw, MW	Mast radiator, non-directional
Gilgili (350 km NW of Kampala)	10 kw, MW	Mast radiator, non-directional
Bobi (240 km north of Kampala)	100 kw, MW	Mast radiator, non-directional
Butebo (156 km east of Kampala)	100 kw, MW	Mast radiator, non-directional
Mbale (195 km NE of Kampala)	2 kw, MW	'T' antenna
Soroti (190 km NE of Kampala)	2 of 250 kw, MW	Dipole array HRS 4/4

The transmitter station at Gilgili was destroyed during the 1978 war. At the time of visit the Kabale station was off the air because of lack of central electricity supply (mains L.T. transformer stolen).

The UBC hopes to rebuild Gilgili station in the shortest possible time, and replace the 2 kw MW transmitter at Mbale with a 10 kw MW transmitter. The under-mentioned new stations will also be built within the next five years.

Kangole (320 km NE of Kampala	50 kw, MW	Mast radiator
Hoima (190 km NW of Kampala)	50 kw, MW	" "
Mukunya (230 km, W of Kampala)	50 kw, MW	" "

Although the Uganda P & T microwave network covers almost all the important towns through out the country, the UBC operates and maintains its own programme links (UHF), except the feed to the destroyed Gilgili transmitter station which was installed by the P & T. The consultant was told that the UBC started installation of its studio/transmitter link network when the P & T's country-wide microwave network had either not started or, in later cases, when the locations of the transmitter stations were such that they did not fall within the P & T priority areas. The standing policy now is that the UBC and the P & T will liaise in all their development programme so that all UBC's projects which require the use of P & T facilities are catered for in the P & T's programme.

Under a project named "Expansion of radio broadcasting in Malawi", the under-mentioned higher power transmitters are being installed in the transmitter stations named below to take over from the lower power transmitters in use:

Ngumbe	50 kw, MW	takeover from 10 kw, MW
Mangochi	10 kw, MW	" " 1 kw, MW
Lilongwe	50 kw, MW	" " " " "
Mzuzu	10 kw, MW	" " " " "
Karonga	10 kw, MW	" " " " "

The 50-watts VHF, FM transmitters at the studio centre being used to provide programme link to transmitter stations give fairly good signals for reception by owners of VHF, FM receivers in and around Blantyre. Wider areas will be covered when the 300-watts VHF, FM transmitters are installed as indicated earlier.

The present medium-wave transmitters cover 60 per cent of the country and 50 per cent of the population. The short-wave transmitters cover 100 per cent of the country. It is expected that about 90 per cent of the country and 70 per cent of the population will be covered when the new transmitters come into operation.

Estimated cost of maintenance and operation

Based on the MBC's broadcast of 104 hours a week on only one national service using a total of 116 kw transmitter output power, it is estimated that the cost of operating and maintaining the service is around $US 370,000.

The breakdown is as follows:	In $US
Cost of power supplies	190,000
" " transmitter spares	60,000
" " studio "	20,000
Salaries and wages of operational staff	100,000
Total	370,000

Workshop facilities and reaction to project

At the time of visit the MBC had just taken delivery of new test instruments which were ordered together with the Corporation's new transmitters; these include an LRC bridge, distortion meter, oscilloscope, digital oscillator and audio generators.

The workshop, measuring 4.6 m x 3 m, is rather too small to accommodate staff engaged on normal studio equipment repair work and workers engaged on fabrication work for the project.

The management of the Malawi Broadcasting Corporation felt that because of political reasons the Malawi Government might not welcome the idea of having a rural broadcasting station whose transmissions cannot be easily monitored. What rather interested the management was the use of VHF, FM as the mode of transmission by the Low Cost Broadcast Project. The MBC intends using this mode of transmission eventually for its national broadcast.

Estimated cost of maintenance and operation

The following estimates are based on the use of three out of the 10 transmission studios and four out of the 13 recording studios throughout the year; and assumes all transmitter stations fully operational throughout the year.

On the above basis, it is estimated that the UBC spends about $US 1,350,000 annually in operating and maintaining its network. This amount reduces to about $US 1,273,000 if the damaged Gilgili station (10 kw) and the Kabale station (100 kw) are left out. The annual breakdown is as follows:

	In $US
Cost of power supplies	758,470 (with Kabale and Gilgili off air)
Cost of transmitter spares	381,200 (333,600 with Kabale and Gilgili off air)
Cost of studio spares	15,000
Salaries and wages of operational staff	354,000

Workshop facilities and reaction to the project

There is a workshop attached to the production block but it is without tools and test equipment; the place looked as if it was once well equipped but had lost almost all the valuable tools and equipment during the war. Obviously the UBC's workshop facilities at the time of visit were such that the Corporation could not host the fabrication of the projects broadcast equipment.

The executives of the Uganda Ministry of Information and Broadcasting showed keen interest in the project and provisionally selected the towns of Masindi and Hoima, important cattle-rearing areas in the western region, as possible locations for the project. VHF, FM transmission for national broadcast is being seriously considered in Uganda as an alternative to medium wave which has proved expensive to operate and maintain. The Ministry's concern is how to introduce the FM receivers to the general public should a firm decision be taken to start this new mode of transmission.

THE SUDAN

The Sudan Broadcasting Services (SBS)

The Sudan, the largest country in Africa - area 2,505,812 km^2 is bordered by Egypt to the north, Chad and the Central African Republic to the west, the Libyan Arab Jamahiriya, Zaire, Uganda and Kenya to the south; and Ethiopia and the Red Sea to the east.

The country is mostly desert, and about 80 per cent of its 17,865,000 population live along the valley of the River Nile which traverses the country from the south to north. It has a desert type of climate with tropical and subtropical steppe to the southern part approaching the borders with Uganda, Kenya and Ethiopia.

Vegetation is largely or entirely absent in the north-western part of the country, otherwise broadleaf deciduous plants, shrubform, grow singly or in patches especially in the south.

Sudan's GNP is $320; the preoccupation of a good percentage of the people is nomadic herding. Cotton, the main foreign exchange earner, is grown in the south; other crops grown are millet, grain sorghum and sesame seed.

Infrastructure

The Sudan Broadcasting Service's (SBS) studios are housed in the ground floor of the organization's three-story administration block in Omdurman, near Khartoum.

There are altogether 12 studios all of the same dimensions (6 m x 4.6 m) but only eight of the 12 studios are equipped for broadcasting. Four of the eight studios are used as recording studios and the other four are used for transmission.

The studio centre is linked to the SBS's six transmitter stations by satellite and microwave both under the control of the Sudan Telecommunications Department. The six transmitter stations, one short and medium-wave station and five medium-wave stations, are located at Omdurman (near the studio centre), Soba (12 km from Khartoum), Sennar (250 km), Juba (1,160 km), Nyala (920 km) and Port Sudan (670 km).

The SBS is at present broadcasting on only one channel as a result of the loss of a radiating mast antenna at its high power transmitter station at Soba during a storm.

Unlike all the African broadcasting organizations visited, procurement of broadcast equipment, their operation and maintenance are the responsibility of the Sudan Telecommunications Department; the SBS is only responsible for the

THE UNITED REPUBLIC OF TANZANIA

The Tanzania Broadcasting Service

The United Republic of Tanzania is bordered by Uganda and Kenya to the north, Zaire to the west and Zambia and Malawi to the south. The Indian Ocean forms the eastern border of the country.

Tanzania has a population of 17,982,000 and covers an area of 945,087 km^2, most of which are undifferentiated highlands; Mount Kilimanjaro, the highest mountain in Africa, is situated a few kilometres from the country's northern border with Kenya.

Tanzania has a GNP of $US 230. The main exports are coffee, cotton, diamonds, sisal, cloves and cashewnuts. In addition to diamonds, minerals such as gold, tin, iron ore and coal are mined in commercial quantities. Holiday tourism also contributes a substantial amount to the foreign earnings of the country.

Infrastructure

Radio Tanzania's broadcast studios and control rooms are housed in the Tanzania Broadcasting Services headquarters located in the industrial area of Dar-es-Salaam, the capital city. There are eight studios in all, including one drama/music studio; each of the seven talks/discussion studios measures 4.5 m x 4 m and the drama/music studio measures about 7.3 m x 11 m.

There are three broadcast channels: the National Service, the Commercial Service and the External Service; these services are radiated by the organization's six transmitter stations. Three of these stations are located near Dar-es-Salaam these are Pagu Road station, Mabibo station and Kunduchi station, and the other three are at Mbeya, Arusha and Mwanza.

There are plans to build three more stations at Dodoma, Kigoma and Machingwea.

Two of the three transmitter stations near Dar-es-Salaam, Pugu Road (500 m from the studio centre) and Mabibo (5 km from the studio centre) are linked to the studio centre by both underground cable and VHF Band II broadcast transmissions from the studio centre. The third Dar-es-Salaam-based station, Kunduchi (15 km away), is at present linked by only the VHF, Band II transmissions. The other three transmitter stations in the country are linked to the studio centre by P & T microwave.

Studios

One of the eight studios is used for commercial broadcasting, three for the National Service and the other three for the External Service; as stated earlier the eighth is a drama/music studio used by all the three services.

The Commercial Service studio is equipped with:

One 5-channel mixer;
Four turntables; and
Three tape recorders.

The National Service studio cubicle is equipped with:

One 5-channel mixer;
Two turntables; and
Two tape recorders.

The External Service studio cubicle is equipped with:

One 8-channel mixer;
Turn tables; and
Three tape recorders

The drama/music studio is equipped with:

One 12-channel mixer;
Two tape recorders; and
Two turntables.

The outputs from all the studios are routed to the one control room serving all the three services. The studio outputs terminate on jackfield sockets, appropriately labelled and mounted on equipment racks in the control room. Also mounted on the racks are other jackfield sockets to which in-coming lines from various outside broadcast venues are connected. From here the programmes are routed to the appropriate transmitters through the microwave link terminals and to the 50-watt VHF, FM transmitters housed in a different room adjoining the control room.

Transmitters

Radio Tanzania's transmitters used for the National Service are located in or near densely populated areas. The output powers of the transmitters are such that they cover as much of the populated areas as possible. The stations are not meant to cover large areas of the country with a view to just achieving 100 per cent country-wide coverage; the reason for this is that large areas of the country are marshy and uninhabitable, e.g., the west-central parts. Also there are large game parks in the country.

Location of transmitters, output powers and antenna systems

Location	Output power	Antenna
Dar-es-Salaam (Pugu Road)	2 of 10 kw, SW	Dipole
	10 kw, MW	'T' antenna
	2 of 1.25 kw, MW	" "
Dar-es-Salaam (Mabibo)	4 of 50 kw, SW	Dipole array HRS 4/4
	10 kw, MW	'T' antenna
Dar-es-Salaam (Kunduchi)	100 kw, MW	Mast radiator

Location	Output power	Antenna
Mbeya (650 km west of Dar-es-Salaam)	50 kw, MW	Mast radiator
Arusha (460 km north of Dar-es-Salaam)	50 kw, MW	" "
	10 kw, MW	" "
Mwanza (820 km northwest of Dar-es-Salaam)	50 kwm MW	" "

The 10 kw, MW, transmitters listed under Pugu Road and Mabibo stations (both near Dar-es-Salaam) were nearing commissioning at the time of visit. These transmitters are to take-over transmissions from the two 1.5-kw MW transmitters at Pugu Road station.

In its expansion programme Radio Tanzania intends putting up three more medium-wave stations. These will be located as follows:

(a)	Dodoma (290 km west of Dar-es-Salaam and proposed new capital city)	100 kw, SW
(b)	Kigoma (1,020 km west of Dar-es-Salaam)	100 kw, MW
(c)	Nichingwea	100 kw, MW

The above new transmitter stations will have studio facilities and will serve as programme originating centres. They will be linked to the studio centre at Dar-es-Salaam by P & T microwave link.

It is expected that 80 per cent of the population will be covered when the new transmitters come into operation as against the present 30 per cent being covered.

Estimated cost of maintenance and operation

With its present transmission hours of 5,772 hours annually for the National and Commercial Services, and another 2,912 hours annually for the External Service, it is estimated that it costs Radio Tanzania $US 1,335,600 to operate and maintain its services. The breakdown is as follows:

	In $US
Cost of power supplies	728,053
Cost of transmitters spare parts	288,000
Cost of studio spare parts	15,000
Salaries and wages of operational staff	304,500
Total	1,334,553

Workshop facilities and reaction to project

There is a fairly well-equipped studio maintenance workshop, dimensions 4.3 m x 4.8 m at the Dar-es-Salaam studio centre for servicing studio equipment which cannot conveniently be repaired in the studio cubicles.

The test equipment seen include low voltage power supplies, electronic multimeters signal generators (both AF and HF) and distoration metres, etc. These should prove useful for the low-cost broadcasting project since they were all fairly new and in good working condition. Unfortunately as the workshop has been designed mainly for equipment maintenance work and not for fabrication of studio equipment, such a major work will disrupt operations at the centre.

Radio Tanzania's main interest in the project was the establishment of rural VHF, FM broadcast stations (the projects mode of transmission) in the country. The engineers feel that it will "open the door" for more such stations to eventually take over from medium wave as the main mode of national broadcast transmission. According to the Engineering Directorate, there would be no difficulty in getting approval from the Government for the project to start if the United Republic of Tanzania were to be selected as one of the countries to host the project. On the question of a possible site for the project, the feeling was that this had to be discusse at governmental level, and that in any case the location should be within 3050 km from Dar-es-Salaam so that the programmes could be easily monitored in the capital.

ZAMBIA

The Zambia Broadcasting Services (ZBS)

Zambia has a population of 5,649,000 and covers an area of 752,614 km^2; the country is landlocked and is surrounded by Zaire and the United Republic of Tanzania to the north, Angola to the west, Malawi and Mozambique to the east and the new Republic of Zimbabwe to the south.

On the average Zambia is about 600 m above sea level with few mountains in the northern part of the country; the natural vegetation is tropical savanna and the main crops are tobacco and peanuts.

Zambia's GNP is $US 480. Copper production is the main industry and chief source of the country's foreign exchange earnings. Other minerals like chromite and manganese are also available.

Infrastructure

The Zambia Broadcasting Services has its headquarters about 4 km away from the centre of Lusaka. In the same compound are the ZBS's radio and television studios as well as the 1 kw Lusaka television transmitter station. The directorate of the ZBS is therefore housed in the same building with the studio (both radio and television) and TV transmitter operational staff a few metres away.

The ZBS broadcasts on three channels; the General Service (English and two local languages), the Home Service (seven other local languages) and the External Service. Commercial broadcasting is done on both the General and the Home Services.

There are five sound recording studios, including three larger ones for drama and discussion programmes, and four continuity studios. The master control room routes the outputs of the continuity studios to the transmitters.

The ZBS has in operation five transmitter stations; two (medium-cum-short-wave stations) are located near Lusaka, the other three (all medium-wave stations) are located in Kabwe, Livingstone and Kitwe. Five more medium-wave transmitters, expected to be comissioned in 1981, will be located in Kasama (northern province), Mongu (western province), Chipata (eastern province Mansa) Luapula Pros and Solwezi (north-western province). The ZBS's aim to semi-decentralize its operation by the establishment of provincial studio/transmitter stations will be realized when the new stations come into operation.

To link the transmitter stations to the Lusaka studio centre, the ZBS utilizes a UHF radio programme link, operated and maintained by the Service, this backed by the transmissions of a 5-kw, VHF, FM broadcast transmitter installed at the Lusaka studio centre to feed the two nearby transmitter stations (Twin Palm, 8 km and Shorthorn, 26 km). In addition Twin Parm is linked by P & T underground cables to the studio centre. The three transmitter stations in the country are linked by P & T microwave.

Studios

With few exceptions, all programmes for transmission are recorded and the taped programmes sent to the appropriate continuity (or transmission) studios for playback. The control cubicles of all the five recording studios are linked by cable to the transmission studios and playbacks for transmission are possible from any free recording studio.

The three drama/discussion studios (dimensions, 5.4 m x 7.3 m) are similarly equipped, each with:

One 12-channel mixer;
Two turntables;
Two tape recorders; and
Two audio cassette tape recorders which are used for recording commercial advertisements.

The other two recording studios are each equipped with:

One 4-channel mixer;
Two turntables;and
Two tape recorders

The continuity studio is actually a talks studio which is being used as continuity and it is the adjoining studio cubicle that is used for the announcements. Three of these four continuity studios are allocated to the General Service, the Home Service and the External Service; the fourth is used as a standby continuity studio to any of the three services. The general, home and the standby studios are equipped with:

One-8 channel mixer;
Three turntables;
Two tape recorders; and
One cassette tape recorder (playback only).

The external continuity studio is similarly equipped but without cassette tape recorders.

As mentioned earlier, taped programmes sent to the continuity studios are played back by the continuity announcer who in addition operates the studio console, plays records and introduces announces programme changes.

The outputs of the continuity studios are fed to the master control room from where they are routed to the appropriate transmitters.

The master control room staff also monitor the outputs of the two nearby transmitter stations at Shorthorn and Twin Palm.

Transmitters

The two near Lusaka based transmitter stations, Shorthorn and Twin Palm, house both medium and short-wave transmitters. The medium power short-wave transmitters (50 kw) used for the External Broadcasting Service are located at Shorthorn while the high power short-wave transmitter (120 kw) located at Twin Palm is used for the General Services. All the provincial transmitters, including the five to be commissioned in 1981 are medium wave transmitters.

Location of transmitters and output powers

Location	Power output	Antenna
Lusaka (Twin Palm, 8 km)	2 of 10 kw, MW	Mast radiator
	100 kw, MW	" "
	50 kw, SW	Quadrants
	120 kw, SW	"
	5 kw, VHF, FM	Horizontally polarized antenna

The under-mentioned transmitters in the above stations are either unserviceable or are to be phased out of service due to obsolescence:

10 kw, MW	Unserviceable
2.5 kw, SW	"
10 kw, SW	"
2 kw, MW	To be phased out
100 kw, SW	" " " "
20 kw, SW	" " " "

Lusaka (Shorthorn, 26 km)	2 of 50 kw, SW	Quadrants
	200 kw, MW	Mast radiator
Kabwe (Central Province)	2 of 2 kw, MW	'T' antenna
Livingstone (Southern Province)	2 of 1 kw, MW	" "
Kitwe (Copperbelt)	2 of 20 kw, MW	" "

The under-mentioned transmitter stations are to be commissioned in 1981:

Location	Power output
Kasama (Northern Province)	2 of 10 kw, MW
Mongu (Western Province)	2 of 10 kw, MW
Chipata (Eastern Province)	2 of 10 kw, MW
Solwezi (North-Western Province)	2 of 10 kw, MW
Mausa (Luapula Province)	2 of 10 kw, MW

With the present transmitters in operation, about 60 per cent of the country and 50 per cent of the population are covered by medium-wave transmission; these percentages are expected to increase to 75 per cent of the country and 60 per cent of the population when the five new transmitter stations are commissioned.

It is estimated that 90 per cent of the country and about 80 per cent of the population are covered by short-wave transmissions from Lusaka.

Estimated cost of maintenance and operation

The ZBS transmits 131.5 hours weekly on each of its two national services, the Home and the General Service with a total transmitter outpower of 567 kw both short and medium-wave (short-wave 220 kw and medium-wave 347 kw); and 42 hours a week on its External Service with a 50 kw short-wave transmitter.

The estimated cost to the ZBS for operating and maintaining the three services works out to about $US 2,198,850. The breakdown is as follows:

	In $US
Cost of power supplies	1,192,654
Cost of transmitter spares	691,200
Cost of studio spares	50,000
Salaries and wages of operational staff	265,000
Total	2,198,854

Future plans

A $US 40 million sound, television and film production complex which will also house the directorates of the Zambia Broadcasting Services, the Zambia Information Services and the Zambia News Agency, is expected to be commissioned in late 1981. The complex includes 18 sound broadcasting studios and control rooms as well as television studios, a TV transmitter hall and antenna system.

A similar radio and television complex (for ZBS only) is expected to be put up at Kitwe, in the Copperbelt Province, before the end of 1982.

Workshop facilities and reaction to project

There are three maintenance workshops at the Lusaka studio centre. The television maintenance workshop is responsible for the day-to-day maintenance of the TV production equipment. The staff from this workshop work mainly in the TV studios and control rooms checking the performance of the TV system.

The studio maintenance Workshop, like its TV counterpart, is responsible for the efficient performance of the sound studio equipment. The responsibility of the staff is, among other things, the alignment of sound production equipment like audio tape recorders and ensuring that correct levels and frequency response are obtained on all line equipment.

All equipment that cannot be serviced easily by both the TV maintenance and sound studio maintenance workshop staff are sent to the general services workshop (dimensions, 6 m x 7.5 m) for repairs. This workshop is well equipped with all the necessary test instruments and tools for the required repair works. The workshop could easily have been suitable for the electronics work of the Low-cost Sound Broadcasting Project but for the radiations from the 1 kw TV transmitter and the 5 kw, VHF, Band II transmitter.

Tools for fabrication work like lathe machine, electric drills and metal bending machines are available at the two transmitter stations near Lusaka and not at the studio centre.

The ZBS directorate informed the consultant that the ZBS would wish to be considered in the project because it is at present going through the difficult task of broadcasting in English and seven local languages (there are more languages spoken in Zambia) and it would be ideal if rural studio/transmitter stations are located in the country (with programme feedback to Lusaka) to broadcast in the languages understood by the people in the areas where they are located. Although economically, Zambia depends mostly on mineral resources, agriculture also plays a vital role in the country's economy and so bringing such an important means of education to the door steps of the rural dweller will go a long way towards improving the output from the rural areas to the national economy as well as raising living standards in the country as a whole.

According to the directorate the district for the implementation of the project, if Zambia were selected, would be decided at governmental level.

MALAWI

The Malawi Broadcasting Corporation (MBC)

Malawi, with a population of 5,817,000 and covering an area of 118,484 km^2 is surrounded by the United Republic of Tanzania in the north and north east; Zambia in the north-west and Mozambique in the south, south-west and south-east.

The country is about 940 km from its northern end to the southern end and the central region is about 260 km east to west.

Lake Malawi, lying almost along the eastern border of the country is about 620 km from north to south and 95 km (widest part) east to west; thus about one-quarter of the country is covered by the lake.

The country averages about 610 m above sea level with the surface of the lake being around 600 m above sea level (the deepest part is about 152 m below sea level).

The natural vegetation is tropical savanna; broadleaf deciduous trees, grass and other herbaceous plant are common.

The economy of the country depends mainly on agriculture and its GNP is $US 180. Tea, tobacco, rice, fish and fish products are the main exports although sugar is fast becoming the country's prime foreign exchange earner, cotton, maize, millet and grain sorghum are also grown.

Infrastructure

The headquarters of the Malawi Broadcasting Corporation is at present housed in a rented four-storey building with a spacious compound, located about 6 km from the centre of Blantyre. The block is adjacent to the office block of the Malawi Police and from all outward appearances was formerly being used by or was meant to be part of the Malawi Police headquarters in Blantyre.

A number of the offices have been converted to broadcast studios, control rooms, and a studio maintenance workshop. There are in all three talks studios and one drama studio, all on the third floor of the building. The master control room is on the fourth floor and on the concrete roof-top is a bi-directional, HF receiving antenna used for monitoring the MBC's short-wave transmissions. Next to the control room are housed the three 50 watt VHF, FM Band II transmitters used as programme links between the control room and the transmitter stations which are not far from Blantyre.

The MBC transmits its National Service (it has no external service) from seven transmitter stations; these stations are located at Ngumbe (near Blantyre), Bangula (80 km from Blantyre), Mangochi (145 km from Blantyre), Nkhota Kota (320 km), Mzuzu (490 km), Karonga (650 km) and Lilongwe (235 km), the new capital city.

Studio facilities exist at the Lilongwe, Mangochi and Karonga transmitter stations. There are also studio facilities at Zomba, about 50 km from Blantyre.

Programme link to Ngumbe, Mangochi and Bangula transmitter stations are provided by the studio centre's VHF, FM link; Mangochi, in addition, picks up programmes off air from the Blantyre-based short-wave transmitter station for rebroadcast; Lilongwe and Mzuzu stations are linked to the studio centre by P & T microwave while Nkhota Kota and Karonga stations rebroadcast programmes picked off air from the short-wave transmitter station at Ngumbe.

Studios

Because the MBC's studios at the Blantyre studio centre were not originally designed as such (formerly offices, converted to studios), they are rather small, especially the control cubicles (dimensions 3 m x 2.4 m) and appear crowded with equipment.

The three talks studios are similarly equipped with:

One 4-channel mixer;
Two tape recorders; and
Two turntables.

The drama studio (dimensions 8 m x 4.3 m) is equipped with:

One 8-channel mixer;
Two tape recorders; and
Two turntables

As stated earlier the MBC has studios at Zomba, Lilongwe, Mangochi and Karonga. Programmes are broadcast live from the Lilongwe, Zomba and the Mangochi studios because of the existence of two-way P & T microwave link between these stations and the studio centre in Blantyre; recorded programme materials are also sent from these three studios as well as from Karonga to the Blantyre studios for broadcast.

The outputs of all the studios, including studios outside Blantyre, terminate in the control room. From here programmes originating from the studio centre and live broadcast programmes from outside are routed to the various transmitters via the programme links; outside broadcasts are similarly connected to either the transmitter stations for transmission or the studios for recording.

The control room equipment are, compared to most of the stations visited, new and modern; push-button switches with indicator lamps are mostly used for programmes selection and routing instead of patch cords.

In the absence of extensive P & T microwave link network in the country, the MBC relies heavily on the use of VHF, FM broadcast transmissions to be picked off air by the transmitter stations within the reception area for rebroadcast. Those stations which are outside the VHF, FM reception area, and are not linked by P & T microwave, rebroadcast programmes received from the short-wave transmitter station near Blantyre.

Out of the seven transmitter stations, three stations, Ngumbe, Bangula and Mangochi rebroadcast signals received from VHF, FM transmissions; Mangochi, which rebroadcasts signals received from the short-wave transmitter station when the VHF signals become noisy.

Nkhota Kota and Karonga only broadcast signals received from the short-wave transmissions. Lilongwe and Mzuzu are linked to the studio centre in Blantyre by P & T microwave.

The output power of the VHF, FM transmitters in use is 50 watts and the antennas are directional. To improve the quality and reliability of the off air VHF signals received at the Bangula and the Mangochi stations, the MBC plans to increase the power outputs to 300 watts by the installation of new higher power transmitters at Blantyre, Zomba and Lilongwe.

Use of these higher power VHF, FM transmitters is supposed to be the start of countrywide VHF, FM coverage in Malawi.

Transmitters

The MBC broadcasts on only one channel and commercial advertisement is carried on this channel. The Corporation has no external service. Both short and medium waves are used for this national service. The short waves are used to cover areas not adequately covered by the relatively better quality medium-wave transmissions; also the short-wave transmissions are picked up for rebroadcast by medium-wave transmitter stations which have not yet been linked to the national studio centre in Blantyre by a reliable programme link.

The location output powers and antenna systems of the transmitter stations are:

Location	Power output	Antenna
Blantyre (Ngumbe)	100 kw, SW	Dipole
(Southern Region)	20 kw, SW	"
	10 kw, MW	Mast radiator
	1 kw, MW	" "
Bangula (80 km south of Blantyre)	1 kw, MW	" "
(Southern Region)		
Mangochi (145 km north of Blantyre)	1 kw, MW	" "
(Southern Region)		
Lilongwe (235 km north east of Blantyre)	1 kw, MW	" "
(Central Region)		
Nkota Kota (320 km north of Blantyre)	1 kw, MW	" "
(Central Region)		
Mzuzu (490 km, north of Blantyre)	1 kw, MW	" "
(Northern Region)		
Karonga (650 km north of Blantyre)	1 kw, MW	" "
(Northern Region)		

production aspect of broadcasting. This arrangement appears to apply to sound broadcasting only since the SBS's television studios and transmitters are manned and maintained by SBS engineers.

Studios

The four recording studios at the studio centre are each equipped with:

One 12-channel mixer;
Four turntables; and
Four tape recorders (desk type)

The above studios, dimensions 6 m x 4.5 m, are in fact used as "general purpose" studios, i.e., for discussions, drama and music.

The four transmission studios are each equipped with:

One 12-channel mixer; and
Four tape recorders (desk type)

There are no turntables in the transmission studios, gramaphone records tend to become dusty easily, especially in a country like the Sudan with its desert type of climatic conditions which when used adversely affect broadcast programmes. The SBS therefore tries to avoid the use of programmes on disc, at least for transmission.

The remaining four studios are expected to be equipped for use by the end of 1981.

Transmitters

The SBS radiates its national programmes on both short and medium waves from transmitters located in the following towns:

Location	Power output	Antenna
Khartoum (Soba, 12 km)	2 of 120 kw, SW	Dipole
	2 of 50 kw, SW	Dipole
	2 of 100 kw, MW	Mast radiator
Omdurman (near Khartoum)	50 kw, MW	" "
Sennar (250 km south of Khartoum)	2 of 750 kw, MW	" "
Juba (1,160 km south of Khartoum)	2 of 100 kw, MW	" "
Nyala (920 km west of Khartoum)	50 kw, MW	" "
Port Sudan (670 km east of Khartoum)	7 kw, MW	" "

At the time of visit, the SBS was having problems with its transmitters. Of the six transmitters at the Soba station, only one of the two 120-kw, SW transmitters was operational, the 100 kw, MW transmitter was without a radiating

mast antenna it collapsed during a storm. Parts have been removed from one of the two 50 kw, MW transmitters to get the other one working (it was still of the air). Khartoum and the surrounding area were therefore being fed from the 50 kw, MW transmitter at Omdurman (under normal circumstances a standby to the medium-wave transmitters at the Soba station) and the 120 kw short-wave transmitter at Soba.

These problems were attributed to the age of the transmitters (average age 18 years); spare parts could not be obtained easily to keep them in operation.

Of the two 750-kw transmitters at the Sennar station, one has never been on the air since installation, and parts had to be removed from it in order to get the second one commissioned. Even there this second transmitter has proved so inefficient (power consumption considered abnormal) that it is rarely used.

The 100-kw, MW transmitter at Juba and the 50-kw, MW transmitter at Nyala were operating on half power also due to lack of spare parts.

The SBS did not appear satisfied with the maintenance services being provided by the Telecommunications Department. There were times when breakdowns were not communicated early enough and at times the quality of the transmitted programmes was so poor that it was suspected that correct programme cables were not being used to link the transmitter stations. The SBS had made and is making approaches to the authorities concerned to get its own engineers and technicians to take over the maintenance and operation of its studios and transmitters, as is being done with its television service.

The SBS estimates that the medium-wave transmissions covered about 60 per cent of the population when all its transmitters were functioning normally, but under the above prevailing conditions it was covering between 10 to 15 per cent.

The 120-kw, short wave transmissions from Soba cover about 90 per cent of the population.

Estimated cost of maintenance and operation

According to the SBS it pays the Telecommunications Department about 3.5 million Sudanese pounds ($US 4.375 million) annually for the maintenance and operation (including salaries and wages of Telecommunications Department engineers and technicians attached to the SBS) of its installations and equipment.

It is estimated that on an annual basis about $US 3.34 million of this amount goes towards:

		In $US
(1)	Cost of power supplies (mostly at transmitter stations)	2,221,400
(2)	Transmitter spare parts	868,800
(3)	Studio spare parts	30,000
(4)	Salaries and wages of telecommunications engineers and technicians attached to the SBS	220,500
	Total	3,340,700

The above figure is based on all studios and transmitter stations equipment functioning normally and transmitting 6,570 hours a year.

Future plans

The directorate of the Sudan Broadcasting Services (also that of the Telecommunications Department) plans phasing out the high-power short and medium-wave transmitters with low power (not more than 1 kw) transmitters in 14 different locations in the country since the near-urban based high-power transmitters have not proved effective in covering the country's present population of nearly 18 million concentrated within few towns and villages in specific areas of the country.

Apart from the difficulties which are being experienced from the operation of the present transmitters, it had been observed that a good percentage of their power, when they functioned normally, was wasted on uninhabited desert areas in the country.

During the planned period, the Telecommunications Department will provide programme link from the studio centre in Omdurman to the 14 towns earmarked for the project. Consideration is also being given to the use of 300/500-watts VHF, FM transmitters as the low-power transmitters to be used in this new project.

Workshop facilities and reaction to the project

There is a small workshop (4.2 m x 3 m) attached to the SBS studio centre where the staff of the Telecommunications Department service faulty studio equipment. The required test instruments are brought in daily for the service or repair work and returned at the close of each day.

There is no properly equipped workshop at the broadcasting house where the "Low-Cost Broadcasting Project's" fabrication work can be undertaken.

The SBS considers the "Low-Cost Broadcasting Project" similar to their new project described above, the main difference being that the SBS is not thinking of studio facilities attached to the low-power VHF, FM transmitter stations now. According to the directorate, this is due to cost since the budget for 14 studios in addition to the transmitters would be too high. The directorate would be pleased if the "Low-Cost Broadcasting Project" would start in the Sudan since it falls in line with their own decentralization project. According to them, most of 14 places chosen for their project are rural areas and any of them could be the location for the Low-Cost Sound Broadcasting Project.

CONCLUSION

Almost all the transmitters in use for national service by the countries visited are high-power medium-wave transmitters with coverage areas of the order of 100 km radius for daytime reception. These transmitters are generally located in urban areas and, in most cases, the rural areas rely on nighttime tropospheric propagation for reception (this is particularly so in geographically large countries like Nigeria and the United Republic of Cameroon).

From discussions with the managements concerned, some of the reasons given for the apparent neglect of the rural areas are poor access roads to these areas and non-existence of amenities such as central electricity supply and easily available supply of water to enable any meaningful construction work to be undertaken.

In an effort to reach these rural areas by radio, most of the broadcasting organizations use short waves in addition to their medium-wave transmitters for the national service and others are, or are planning to, increase the output powers of their medium-wave transmitters to achieve full national coverage.

The quality of short-wave reception, as compared with medium wave is poor; and without the use of expensive receivers the content of the short-wave broadcasts tend to be unintelligible. Strong clear signals similar to those obtained in most urban areas is what is generally required to provide effective communication.

Increasing output power of transmitters does not fully solve the problem either, because there is a limit above which the law of diminishing returns in coverage areas sets in.

All the broadcast organizations visited are faced with the problem of having to broadcast in several local languages in order to reach all sectors of their multilingual communities especially those in the rural areas. Consequently with their present studio/transmitter set-up close to the capital cities, except Nigeria and to some extent the United Republic of Cameroon which operate semi-autonomous "regional broadcast stations", one out of a possible two national transmissions, usually called the home service, is devoted to broadcasts in a few of these languages, usually the ones understood by the majority of the population. The daily programmes on this service are translations into the various languages of English or French languages news bulletins and other topical national events and direct productions of periodical cultural and educational programmes in one of the national languages. This service is meant primarily for the rural areas, but because of the weak broadcast signals in these areas, the main purpose of the programme is often lost.

In an effort to solve this problem, Nigeria and the United Republic of Cameroon have introduced semi-autonomous regional or state broadcast stations where each region or state has its own studios and transmitter complex with its own administrative, technical and programme staff. The programmes from these stations are mainly on the activities of their respective regions or states, and the medium of broadcast is the local language or languages spoken in the region or the state; in this way, broadcasting in several languages from one

studio centre on one network or service is reduced to two or three languages over transmitters located in the target areas and adequate signal strengths are achieved in these areas.

Even with this marked improvement in the coverage of their rural areas, both the United Republic of Cameroon and Nigeria feel there is still more to be done in getting closer still to the rural dweller. To this end, the Radiodiffusion du Cameroun is using a "mobile station" - a vehicle equipped with studio equipment and a low-power transmitter - which travels from one remote area to another to cover activities and to broadcast locally produced programmes in the areas. The 19 "state radios" of Nigeria, unlike the United Republic of Cameroon are required by law to confine their radio broadcasts (medium wave) within the states, choice of sites for the stations are therefore limited with the result that some states are finding it difficult to extend their present service. To overcome this, some of these states are using on experimental basis VHF, FM broadcast, which has the advantage of easily having its transmissions directed to wanted locations; however another problem here is the lack of VHF, FM radios in the states to receive the programme.

VHF, FM broadcast is gaining popularity with the majority of the broadcast organizations visited in spite of the fact that VHF, FM receivers are not easily found in the shops. The Ghana Broadcasting Corporation is installing two 5 kw, VHF, FM stations in the upper region of the country; the Federal Radio Corporation of Nigeria is broadcasting stereo in the Lagos zone with 20 kw VHF, FM transmitter; the Radiodiffusion du Cameroun has already passed the experimental stage with a 50 watt VHF, FM transmitter at Yaounde and a 60 watt VHF, FM transmitter at Douala; the Voice of Kenya will soon start work on the installation of three 10 kw VHF, FM transmitters, one near Nairobi, another at Kisumu and the third about 90 km north of Nairobi; the Zambia Broadcasting Service is transmitting on VHF, FM with a 5 kw transmitter in Lusaka area; the Malawi Broadcasting Corporation has taken delivery of four 300 watt transmitters which it intends to use both as experimental VHF, FM broadcast service and a studio-transmitter programme link. With the near collapse of its high-power medium-wave transmitters, due mainly to difficulties in obtaining spare parts coupled with operational costs, the Sudan Broadcasting Service is planning to install low-power (300/1000 watts) VHF, FM transmitters in the main towns and cities to eventually replace the operationally costly short-wave and medium-wave transmitters used for national broadcast.

The high cost of keeping the existing broadcast equipment running - especially the transmitters - is a major concern to all the African broadcasting organization visited. The main contributions to these high running costs are power supplies which have been affected by the recent increases in the cost of petroleum (in this case diesel fuel) and the ever-increasing cost of spare parts. Much of the equipment for which the spares are required is becoming obsolete, so special orders have to be placed with suppliers months in advance before they can be obtained, and at prices at times more than double what they normally would have cost.

All the organizations visited are State-owned, and the complaints are that the annual subvention provided by the State administration does not usually reflect these price increases; yet the programme outputs are expected to be normal or even improved upon.

Considering the above points and observations, the conclusion arrived at is that those African countries that have experimented with and are now seriously planning the use of VHF, FM transmission for nationwide broadcast have taken a step in the right direction. Apart from better programme quality that can be obtained from VHF, FM, this mode of transmission requires much less transmitter output power to cover the same area as medium wave. Again the efficiency of a VHF, FM transmitter is higher (50 per cent) than that of its medium-wave counterpart (34 per cent) which means less power consumption for the VHF, FM transmitter.

The main disadvantages of VHF transmission as compared with medium wave is that its propagation is by "line of sight". Therefore nearby hills and mountains form obstacles in the path of propagation thereby "shielding" would-be reception areas from the transmissions. Medium wave, which relies on ground waves for its propagation, does not suffer from this defect, a defect which has been overcome by the use of VHF, FM transmitters.

One point currently being made against the use of VHF, FM broadcast in African countries is that the cost of its radio receiver is too high for the rural dweller. But it is the feeling of a number of African broadcasters that this point is being exaggerated.

Effective rural broadcasting

Mention has been made of the various methods used by organizations to get their broadcasts to the rural areas more efficiently; the main difficulty appears to be the language in which to communicate effectively to the rural dweller. In some cases the broadcast organizations have to consider as many as over 30 different languages (with dialects) spoken in all parts of the country to decide which ones to put on the air as the main ones; often the decision becomes political.

The "mobile station" operated by the Radiodiffusion du Cameroun offers a partial solution to this problem but how frequently does the "mobile station" visit a particular rural area? The villagers in the area would be definitely pleased to see the van, would stop all activities and gather round it looking at it as something more of curiosity than serious source of information, until its mission is over and then would go away expecting it would not be long before it called again.

A more lasting solution is a permanent low-cost station in the area using, to a great extent, locally fabricated studio equipment with a low power transmitter (VHF, FM because of its low power consumption).

The advantage of the locally fabricated equipment is that it makes it easier to extend the project to other rural areas at minimum cost in foreign exchange. This locally fabricated equipment may not be as sophisticated as the more expensive and factory produced one but should at least perform the job for which it is designed.

The studio buildings, and equipment do not also require the same sophistication as those in the urban areas - in fact they will look out of place if they do. Furthermore because of the rural nature of the areas very negligible accoustic treatment of studios will be required. One main problem here may be electricity power supply but with a transmitter having an output power of between 100-300 watts and the type of studio described above, not more than 1,500 watts will be required for the whole station and serious investigation should be conducted into the use of solar energy to power such a station. In the meantime 2 or 3 KVA diesel generator should adequately handle the power needs of the station in the absence of main electricity supply.

Host country

Based on the technical facilities available in the organizations visited and also considering the ease in purchasing some electronic components on the local markets to make for smooth fabrication work, some countries in order of preference are being recommended in a separate note to host the fabrication of the equipment for the "Low Cost Sound Broadcasting System" model station.

Terms of Reference for a Field Study on the Feasibility of a Low-cost Sound Broadcasting System for Rural Communities in Africa

I. Objective

The purpose of the study is to promote social and technological change by facilitating the extension of sound broadcasting coverage areas and improvement of mass communications in African countries through the use of low-cost sound broadcasting systems. To this end the study shall:

(i) provide an analysis of major sound broadcasting systems currently in use in countries to be covered by the field mission;

(ii) provide an analysis the coverage areas in terms of the national geographical areas and population achieved by the existing systems and the related costs in capital and operational terms; and

(iii) determine the feasibility of and proffer a model of low-cost system as an alternative to the traditional large-scale technologically advanced systems currently in use.

II. Scope of consulting services

A. General

The study shall cover twelve countries of the African Region (to be selected with due regard to estimated needs and geographic considerations).

The consultant shall undertake all necessary and related studies, field investigations and related work that may be required to attain the objectives indicated in section I above. In the conduct of this work, the consultant shall co-operate fully with governments/national broadcasting institutions which will provide information and services as outlined in section III below; he shall be solely responsible for the analysis and interpretation of all information received and for the recommendation received in his report.

B. The study

(i) The consultant shall review and analyse:

(a) the technology of existing sound broadcasting systems;

(b) the availability of programme production facilities and their availability to rural communities;

(c) the coverage of transmission and other broadcast programme dissemination facilities in relation to the geographic distribution of the rural communities within each country concerned; and

(d) the operational costs and maintenance skills required to keep the system for rural community coverage;

(e) the feasibility of establishing workshop/laboratories equipped with low-cost tools and instruments within each national broadcasting institution studied, for fabricating components of such low-cost system.

(ii) The consultant shall, in the light of the above, provide:

(a) a practical working model and financial details of the low-cost system that may be recommended;

(b) technical and cost details and drawings for a workshop/laboratory for fabricating the recommended model;

(c) recommendations on the selection of a national broadcasting organization with the capability for a one-off fabrication of components of the model that may be required to be fabricated;

(d) recommendations for the field testing of the model system.

(iii) The consultant shall be required:

to supervise the assembly of the complete model system and supervise the field testing of same over a period to be stipulated.

C. Reports and time schedule

The consultant shall commence field work within thirty calendar days of reporting for duty at the ECA Secretariat headquarters, Addis Ababa, and shall submit the following reports within the time periods indicated:

(a) draft final report of the field study within six calendar months of the effective date of contract;

(b) draft final report on the fabrication and field testing of the low-cost model broadcasting system within twelve calendar months of the effective date of contract.

The reports shall contain a concise summary of all relevant findings and recommendations; estimates of costs and benefits and maps wherever necessary.

The draft final reports shall be carefully edited and complete.

III. Data and facilities to be provided by national institutions/countries

A. Technical data

The national organizations responsible for broadcasting will, on behalf of the governments of the countries selected, provide the consultant with all available information on their sound broadcasting activities and development plans.

B. Co-operation of government agencies

For work that requires the co-operation of other government agencies, the countries concerned will provide a liaison officer who will ensure that the consultant has access to all information required for the completion of the study.

C. Facilities

Wherever necessary the relevant national institution of the participating countries will assist the consultant in the performance of his service, to find the following facilities:

(a) office space, furniture, equipment and office supplies
(b) local transportation
(c) hotel and other accommodation.